APPENDIX 7-11

IPA Piezometer Sampling Information

UtahAmerican Energy, Inc.

R. Jay Marshall P.E.

IPA HOLES DRILLED FOR WATER-LEVEL MEASUREMENTS ONLY

In late 1993 and early 1994, Intermountain Power Agency (IPA) drilled three coal exploration holes that were completed as water level piezometers for the South Lease Coal Property in northeast Emery County, Utah.

The exploration holes were drilled to gather information about the physical and chemical qualities of the coal contained within the IPA South Leases and afterwards to obtain water-level measurements. The coal quality holes were completed to allow for the gathering of water-level measurements only. There was never any intention of collecting water quality data from the three exploration holes.

The completion reports were submitted to the BLM, as required by regulation, on December 16, 1998. The completion reports clearly state "Each drill hole was completed as a monitoring well to allow collection of water-level measurements." The completion report go on to state "Periodic water-level depth measurements are subtracted from the surveyed wellhead elevations to facilitate development of potentiometric surface contour maps." (See Exhibit A)

The permit application clearly states in Chapter 7 "The piezometers were installed to provide depth of water only. It is impossible to drop a bailer 1,000 feet and withdraw a water sample without contaminating the sample. . . . Therefore the depth and diameter of the piezometers holes make it impossible to use them for baseline quality." (see Exhibit

B)

Two methods, pumping, and use of a bailer, are commonly used to obtain water samples for quality analysis.

Pumping (not an option)

To obtain a water quality sample by pumping, a pump must be inserted to the bottom of the well, so that the entire water volume within the well bore can be purged a minimum of 3 times to obtain a representative sample of water from the water bearing zone. In the case of the IPA piezometers, a steel casing with a 2-3/8-inch inside diameter and a 20-foot length of 2-inch inside diameter wire-wound stainless steel screen was used to complete each well. This limits the size of pump to less than 2" diameter.

All IPA holes have a bottom depth of greater than 1,000 feet. In the case of IPA #1, the deepest well, a pump would have to be less than 2" in diameter and capable of pumping a maximum of 1,730 feet of head (See Exhibit C-1 and D). To adequately purge the standing water in the well the volume of water standing in the well casing plus the volume of water within the surrounding gravel pack would need to be removed. Based on standard sampling protocol, to properly purge IPA #1 a minimum of 3 volumes would need to be extracted. For this well, that volume would be 879.5 gallons (see Exhibit D).

Based on information that the Division provided regarding a possible 2-inch diameter sampling pump, on December 16, 2005, the Operator contacted Evan Bennett who is the son of the owner of Bennett Pumps, of Amarillo Texas. Mr. Bennett told the Operator that "they do not make a 2" pump that will pump 1700 feet of head, 1000 feet is maximum". Further more, Mr. Bennett was "not aware of any manufacture who builds a small-diameter pump that will pump any deeper that 1,000 feet".

Exhibit E shows the pump curve for the Bennett pumps. This curve represents the head that water can lifted too. However, it does not account for head losses in the discharge line. As can be seen, the Bennett pump will lift water to 1175 feet with 0 flow. Once the friction and connector losses within the discharge line are accounted for, the effective head limit on the pump is 1,000 feet.

The depth to water in IPA#1 is 1100+ feet. Therefore, the pump would not even lift the water to the ground surface, much less be able to purge the well bore. In the case of IPA #3, the shallowest of all the wells, a pump could reach the water and lift a very limited flow to the surface. Based on the pump curve and accounting for friction losses in the pipe the flow rate would be about 0.1 gpm. Therefore, to be able of purge this well, the pump would need to operate continuously for a minimum of 8.3 days, before a sample could be obtained. From a sampling stand point this is impractical.

Additional research was conducted by the Operator to determine if any other pumps or sampling equipment were available. Exhibit F lists the groundwater monitoring and sampling equipment available from a number of manufacturers and vendors for various sampling options. Based on this research, no manufacturer, supplier, or vendor provides a pump that will be able to meet the sampling requirements.

Additionally, the sampling equipment for this system would make the sampling effort impractical. Access to these wells is limited to the use of ATV to prevent significant disturbance to the site area. The tubing for the sampler is provided on 500 foot rolls each weighing 300 pounds. To be able to sample these wells UAE would need a minimum of 4 rolls with a power winch to be able to lift the pump and tubing into and out of the holes. Based on the weight and bulk of the equipment it would not be practical to utilize this setup to sample the wells.

Thus, pumping to obtain a water quality sample from these wells is not considered a viable option.

Bailer (not an option)

The U.S.G.S. Water-Quality Sampling Protocol (U.S.G.S., 1995 and 1999) recommends that if possible avoid a bailer (see Exhibit G). In the case of IPA #1, the use of a 48" bailer to purge the required volume would be the worst-case situation. The sampling efforts would require dropping and retrieving a bailer 14,658 times at an average depth of 1,420 feet (see Exhibit "D"). This would amount to lifting 21,797 lbs over 1,420 feet. This is impractical for a sampling effort.

Additionally, there are two problems with this method of sampling. First, the use of a bailer in a well that is constructed with steel casing for which you a sampling for iron will lead to contamination problems. As the bailer is lowered and raised within the well, it will hit the side of the casing an knock off rust that has formed on the inside of the casing from water drips off of the bailer from previous sampling. This rust will either collect in the bailer or fall into the standing water in the well, thereby contaminating the sample. Second, the rust particles which collect in the bailer will over time collect near the bottom seat valve of the bailer and preclude it from closing completely. When this occurs, when the bailer is removed from the water, the bailed sample will drain out before the bailer can reach the surface.

Based on these contamination and mechanical problems and the sheer volume of the bailing effort, the use of a bailer to obtain water quality information for these conditions is not considered a viable option.

As discussed in Chapter 7, adequate ground water information exists without quality information from the IPA piezometers. A minimum of two years of baseline groundwater information has been collected by the Permittee on 10 springs on and adjacent to the permit area. In-mine ground water and mine water discharge samples from the Horse Canyon Mine have been collected. Mine water discharge samples have been collected for a minimum of two years on a monthly basis from sites 001 and 002. Two years of in-mine ground water samples were collected from underground sample site 1E2 : 1E-B. Two full years of ground water samples were taken from the underground sump at 2E-B (Results can be found in VI-1 of Part "A"). As this water is from the same seam as will be mined in the Lila Canyon Mine, these samples represent the same water quality.

Early in the Lila Canyon Mine sequence, the mine will breach the existing flooded exploration entries. It is from these entries that the mine water will be obtained for use in the mining process at Lila Canyon. The quality of the water in the exploration entries is the same water as was sampled from the in-mine sites. Thus, the water encountered in the Lila Mine, is expected to be consistent with the quality of the underground water found at sites 1E2, 1E-B, 001, 002, and 2E-B.

REFERENCES:

U.S.G.S., 1995. Ground-Water Data-Collection Protocols and Procedures for the National Water-Quality Assessment Program: Collection and Documentation of Water-Quality Samples and Related Data. OFR 95-399. Washington, D.C.

U.S.G.S., 1999. Field Methods for hydrologic and Environmental Studies. Volume 4. Ground-Water-Data Collection. OFR-01-50. Urbana, Illinois.

Exhibit "A"

2.6 Construction of Monitoring Wells

Each drill hole was completed as a monitoring well to allow collection of water-level measurements. Steel casing with a 2-3/8-inch inside diameter and a 20-foot length of 2-inch inside diameter wire-wound stainless steel screen was used to complete each well.

Based on previous drilling experience in the area and the grain size of the rock in the screened interval, a 20- to 40-mesh silica sand filter-pack and 0.010-inch screen aperture was selected for installation in the wells. The screens were installed 40 to 100 feet below the Sunnyside coal seam.

After placement of the screen and casing, the filter pack was emplaced through a one-inch diameter tremie pipe. The sand was poured slowly into the tremie pipe and washed into the hole with water to prevent bridging in the pipe. Sufficient material was emplaced to extend the filter-pack approximately 15 feet above the top of each screen. Bentonite slurry was then emplaced via tremie pipe to a thickness of about 5 feet on top of the filter pack. The remainder of the annulus between the drill hole wall and the casing was then sealed with neat cement grout with approximately 5 percent bentonite added to reduce shrinkage.

The wells were drilled and sealed in a manner which minimizes disturbance of the prevailing hydrologic balance. Lockable surface casings were installed to protect the integrity of the wells. Well completion diagrams are contained in Appendix C.

After drilling and completion, each well was surveyed with GPS equipment to provide horizontal and vertical control. Periodic water-level depth measurements are subtracted from the surveyed wellhead elevations to facilitate development of potentiometric surface contour maps.

Exhibit "B"

for the South Lease by I.P.A. Monitoring of water depths at these points by UtahAmerican commenced in December 2000 and continued through present. As indicated by the data in Appendix 7-1, the water levels in the holes show very little fluctuation. Levels change from less than 1.2' to a maximum of 21.2' over an eight year monitoring period. Figure 7-2A and 7-2B present the seasonal fluctuations of the water levels as contour maps and hydrographs. Using these water levels, an estimate of the projected water level assuming that the zones from the individual piezometers are connected is shown on Plate 7-1 and the monitoring results are included in Appendix 7-1 - Baseline Monitoring.

The piezometers were installed to provide depth of water only. It is impossible to drop a bailer 1000 feet and withdraw a water sample without contaminating the sample Therefore the depth and diameter of the piezometers holes make it impossible to use them for baseline quality.

Drill holes S-26, S-27, S-28, and S-31 were cased in 3" PVC pipe with bottom perforations for water monitoring; however, cement seals were faulty, allowing the PVC pipe to fill with cement. Drill hole S-26 was reported dry in the week prior to cementing.

It has been reported by Kaiser that holes within one and one-quarter miles east of the cliff face were drilled with air, mist and foam and did not detect any water in the subsurface with the exception of drill hole S-32. No apparent increase in fluid level could be attributed to groundwater inflow from these holes, some of which were open for two weeks. Exploration drill holes in the South Lease property south of Williams Draw did not encounter groundwater within 1 to 1.25 miles of the coal outcrop. Exploration drill holes in the South Lease property, south of Williams Draw, did not encounter groundwater within 1 to 1.25 miles of the coal outcrop.

S-32 is located approximately three miles south of Lila Canyon and is separated from Lila by at least two known fault systems. The drill log along with the Chronology of Development and Pump tests are included in Appendix 6-1. Water levels measured are shown in the `"Chronology of Development". Water quality analysis for S-32 is also included in Appendix 6-1. The location of S-32 is shown on Plate 7-1. The Permittee visited S-32 in 2002 and attempted to measure water levels, but found that piezometer S-32 was unusable.

<u>Spring and Seep Data.</u> JBR Consultants Group (1986) conducted a spring and seep inventory of the Horse Canyon area during the fall of 1985. During

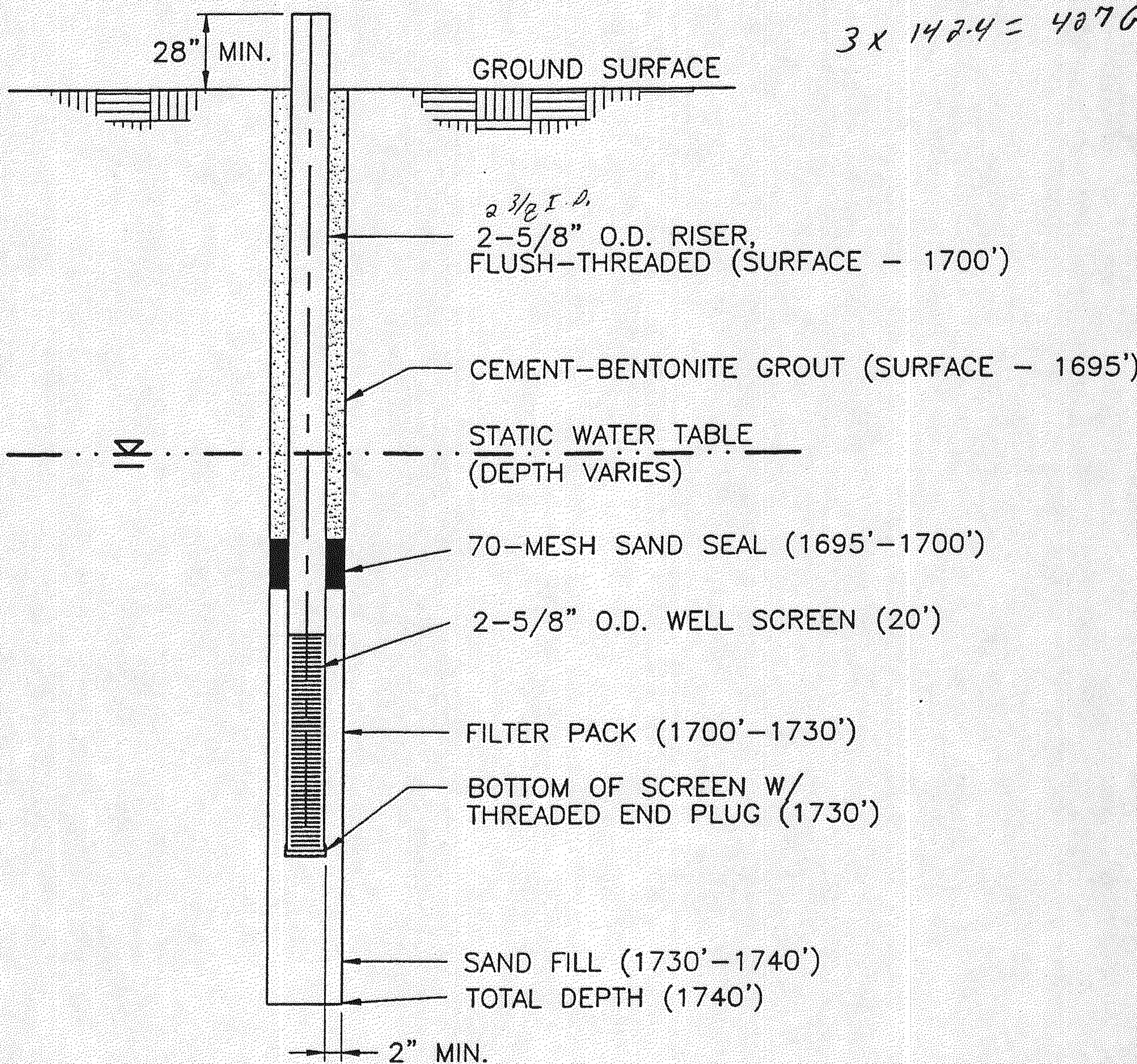
Exhibit C-1

H_2O Elevation 3/29/05 1110.88

Pump depth = 1730 Feet

water column 1730'
1111'
619' = 142.42 gallons

3 x 142.4 = 427 Gallons



N.T.S.

FIGURE 1. IPA-1 COMPLETION DIAGRAM

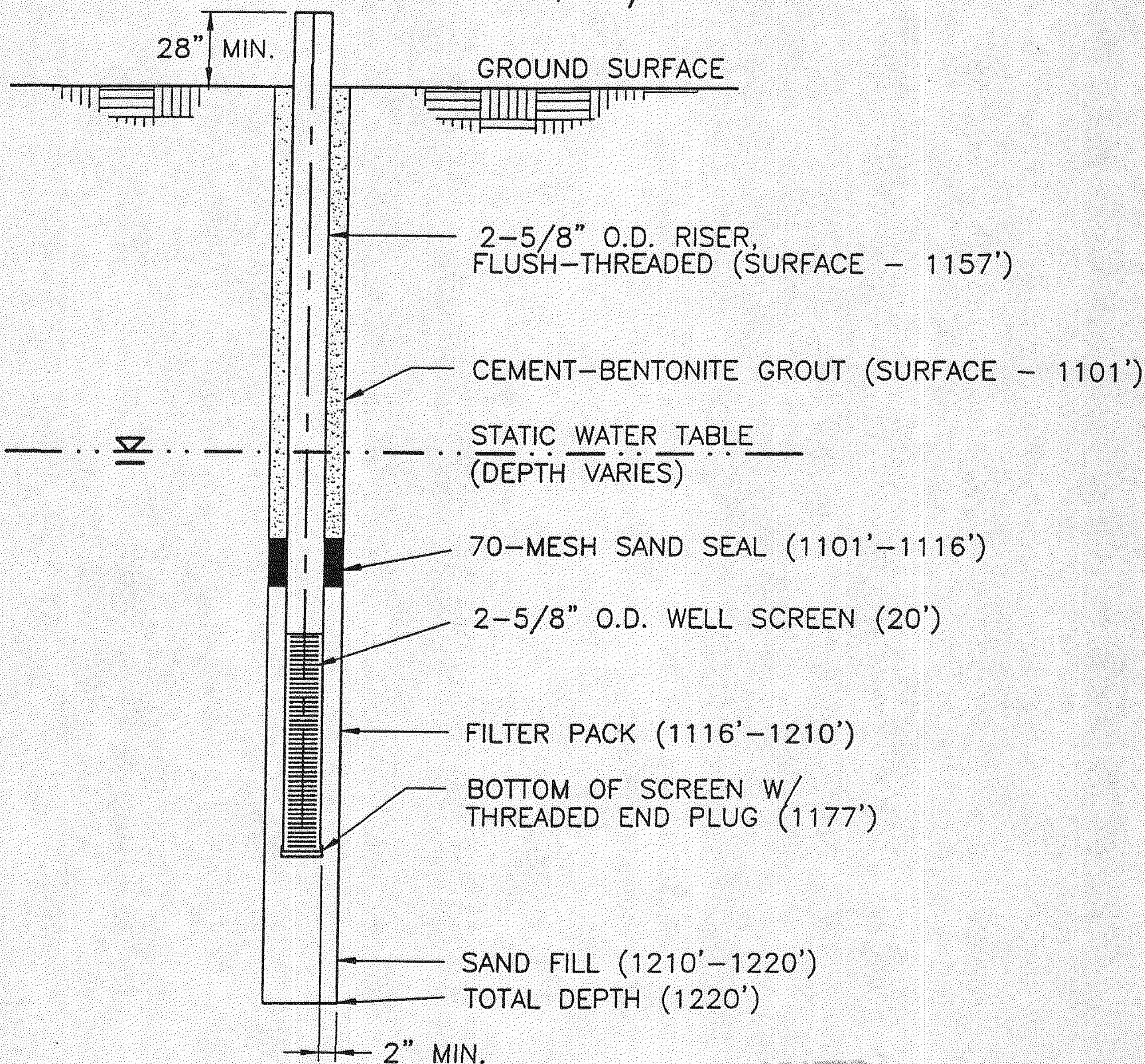
EarthFax

Exhibit C-2

H_2O Elevation 3/29/05 900.38

water column = 1177
900
277 Feet = 64 gallons

Pump depth = 1177 Feet   3×64 = 191 gallons



N.T.S.

FIGURE 2. IPA-2 COMPLETION DIAGRAM

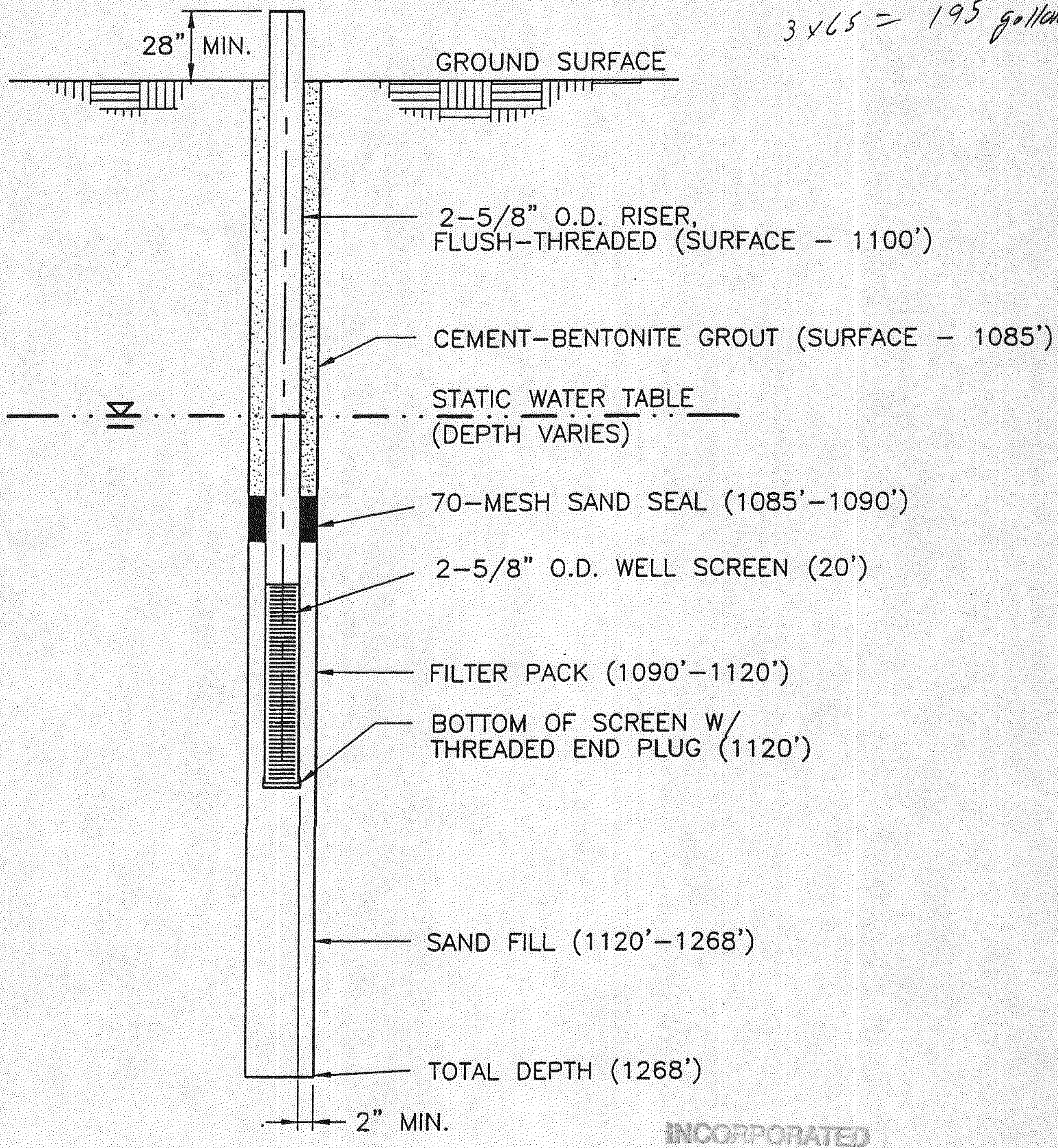
EarthFax

Exhibit C-3

H_2O Elevation 3/09/03 839.04

water column 1120
-839
281 feet = 65 gallons

3x65 = 195 gallons



N.T.S.

EarthFax

FIGURE 3. IPA-3A COMPLETION DIAGRAM

Exhibit D

Sampling Requirements

Piezometer	Screen Depth (ft)	Static H20 Level (ft)	Water Column (ft)	Casing Water Column (gal.)	Bore Water Column (gal)	Total Water Column (gal)	Minimum Purge Gallons	Weight to Purge (lbs)	Trips with Bailer (.18gal)
IPA #1	1730	1110.88	619.12	142.47	737.03	879.50	2638.50	21979	14658
IPA #2	1177	900.38	276.62	63.66	329.30	392.96	1178.87	9820	6549
IPA #3	1120	839.24	280.76	64.61	334.23	398.84	1196.51	9967	6647

		in	dec	ft	
Well	diameter	2 3/8	2.375	0.1979167	
	radius		1.1875	0.0989583	
Bore	Diameter	8	8	0.6666667	
	Radius		4	0.3333333	
	gallon	8.33 lbs		0.1336898	FT3
	Ft3	7.48 gal			

Exhibit "E"

Bennett Sample Pumps

U.S. Patent No. 4295801 • Canadian Patent Nos.1166075 & 1187331

MODELS 180 & 1800
(for 2" and larger wells)

SPECIFICATIONS

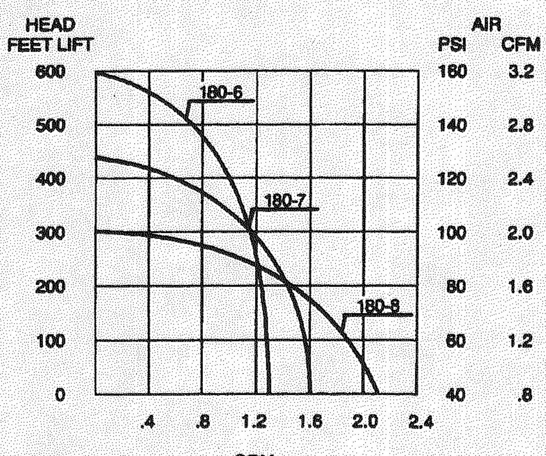
PUMP MODEL NO.	DIAMETER	LENGTH	WEIGHT	MOTOR CYLINDERS	PISTON STROKE	PISTON CYCLES PER MINUTE
180	1.8"	1 9.625"	10.5 lbs.	1	3"	Variable from 0 to 90 CPM
1800	1.8"	23.625"	13 lbs.	2	3"	maxium

Materials of Construction: 303 and 304 Stainless Steel

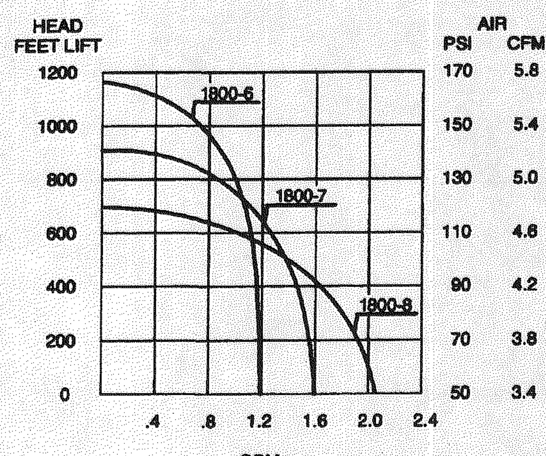
Model 180 and 1800 pumps are equipped with a 1" diameter *pump piston for maximum* flow rates at low pumping lifts. Intermediate lifts require a 7/8" diameter pump piston that reduces the flow rate. High lift applications require a 3/4" diameter pump piston with further reductions in pump flow rate.

PUMP PERFORMANCE CURVES
COMPRESSED AIR REQUIREMENTS

MODEL 180-6—3/4" Pump Piston
MODEL 180-7—7/8" Pump Piston
MODEL 180-8—1.0" Pump Piston



MODEL 1800-6—3/4" Pump Piston
MODEL 1800-7—7/8" Pump Piston
MODEL 1800-8—1.0" Pump Piston



The performance curves show maximum flow rates at given lifts. Lower flow rates are obtained, at any lift, by reducing the air pressure to the pump motor.

GROUNDWATER MONITORING AND SAMPLING

EXhibit "F"

Manufacturer	Types of Groundwater Devices/Sampling Equipment									Sampling Pumps/ Sampling Devices						Samplers				Probes			Sensors/Instruments						
	Direct Push Ground Water Sampling Equipment	Complete Turnkey Groundwater Monitoring System Projects	Well Drilling Services	Well Sampling Pumps	Well Samplers	Well or Water Level Sensors	Well/Water Monitoring Instruments	Hand Driven Soil or Shallow Well Probes	Soil Monitoring or Vapor Extraction Instruments	Line Powered	Battery Powered	Air Powered/Air Lift Types	Pneumatic Bladder Pumps	Minimum Well Diameter Accommodated (Inches)	Range of Water Lift Capabilities (Feet)	Bailers	Kemmerer Samplers	Multi-Sampler Packages	Automated or Programmed Samplers	Power Driven Probes	Manual Probes	Maximum Probe Depth (Feet)	Water Level or Depth Instruments	Battery Option	Minimum Casing Diameter Required (Inches)	Maximum Depth Measurement Capability (Feet)	Well Contaminant Monitoring Instruments	Soil Contaminant Measuring Instruments	Instruments Integrated Into
A M S Inc. 208/226-2017, 800/635-7330	●	●		●	●	●	●	●	●	●	●	●		1/2	1000	●		●		●	●	200	●	●	1/2	300			3
Ametek Drexelbrook 215/674-1234						●	●																●		3/4	3000			3,6
Bennett Sample Pumps Inc. 806/352-0264				●								●		1.5	0-1000														
Blackhawk Environmental Co. 630/469-4916				●		●				●		●		2	800								●		4	150			3,4 6
Campbell Scientific Inc. 435/753-2342						●	●																●	●	1	1000	1,2 5		3,4 6
Chemetrics Inc. 800/356-3072									●																				
Cole-Parmer Instrument Co. 847/549-7600				●	●	●	●		●	●	●				25	●	●		●				●		2	250			
Durham Geo Slope Indicator 770/465-7557, 800/837-0864					●	●	●				●	●		2	200						●	1000	●	●	2	1000	5		
Fultz Pumps Inc. 717/248-2300							●			●	●			2	200			●											
General Oceanics 305/621-2882					●													●											
Geoprobe Systems 785/825-1842, 800/436-7762					●	●	●	●	●											●	●	100	●		1.0	200			
Geotech Environmental Equip. 303/320-4764, 800/833-7958				●	●	●	●	●	●	●	●	●		.75	0-1000	●							●		.75	0-1000			
Global Water Instrumentation 916/638-3429, 800/876-1172				●		●	●			●	●			2.5	up to 200								●		1	500			6
Hach Co. 800/227-4224										●	●								●	●			●				1,2	1,2	3,4 6
Horiba Instruments Inc. 949/250-4811							●																		2	400	5		
In-Situ Inc. 307/742-8213					●	●	●			●	●			1/2	varies			●	●				●	●	.72	1153	1,2 5		3,4 6
Instrumentation Northwest Inc. 425/822-4434, 800/776-9355		●		●	●	●	●			●	●			2	up to 600								●	●					3,4
Jensen Inert Products 954/344-2006,					●											●													
Kavlico Corp. 805/523-2000						●			●														●		1 1/4	6750			6
M M C International Corp. 516/239-7339						●	●																●	●	2	165			
Myron L Co. 760/438-2021							●																						
Nepcco 352/867-7482				●	●	●	●		●	●	●			2	200	●							●	●	2	1250	1,2 5		
Pressure Systems Inc. 757/865-1243						●																	●			700			3,4
Q E D Env'l Systems Inc. 734/995-2547, 800/624-2026	●	●		●		●	●					●		3/4	1000								●	●			1,2 5		3
Sentex Systems Inc. 973/439-0140							●		●																		1,2 5	1,2 5	
Solinst Canada Ltd. 905/873-2255, 800/661-2023	●			●	●	●	●	●			●	●		.375	500	●					●	2000	●	●	.375	6000	5		3,6
Stevens Water Monitoring 503/469-8000						●	●		●														●	●	2	1000			3,4 6
Telog Instruments Inc. 585/742-3000						●																	●	●	2				3
Turner Designs 408/749-0994							●			●	●			2					●	●		600			2	600			3
Uehling Instrument Co. 973/742-8710						●	●																●		2	346			3
Unidata America 503/697-3570						●	●																●	●	2	300			3,6
YSI Inc. 800/897-4151						●																	●		2"				

KEY
1 Alarm Option
2 Automatic Phone Dialing
3 Computer Data Acquisition Systems
4 Plant or Area Networking Systems
5 Recording/Reporting Options
6 SCADA Systems

Exhibit "G"

OTHER PURGE CONSIDERATIONS

- Lack of stability may indicate problems with well design or purge set-up and method
- Generally, Eh will stabilize last, followed by DO.
- If feasible water level in well SHOULD NOT be drawn down below top of open interval. Water levels can be monitored by e-tape or transducer and data used with flow rate to compute specific discharge
- Flow rate should be measured: use a gallon jug, 5-gallon pickle bucket, etc.
- **Micro (low-flow) -purging** at flow rates that approximate 0.1 gal/min theoretically withdraw water along a single flow line and do not induce negligible drawdown in the well. Purge volumes are measured in tubing volumes and pumps are located in the open interval of the well.
- For **continuously pumped wells** flush lines and pressure tank (if present); record field measurements 5 times at regular intervals prior to sampling; 3-5 casing volumes not required
- For **low-yielding wells** empty the well once and wait for 90% recovery

WATER-QUALITY SAMPLING PROTOCOL

- Monitoring wells
  - Use a submersible sampling pump (portable or dedicated) or a bailer appropriate for environmental sampling. If possible **avoid** the use of **bailers**; if necessary **use with bottom-emptying device**.
  - Collect sample at a flow rate of about 0.1 to 0.5 gal/min. For volatile organic compounds (VOC's a rate < 0.5 is recommended. A flow rate of 0.1 gal/min is not feasible for many pumps. Use a flow rate of about 0.1 gal/min for low-flow sampling. **Constant rate, non-turbulent flow for all samples.**
  - Store bottles at the ambient temperature or less of ground water (about 55° F)
  - Use laboratory, quality-assured and cleaned bottles that are securely capped
  - Select proper bottle type for sample (polyethylene, baked glass, amber glass, etc.). Sample bottles for inorganic compounds are rinsed with sample water (unfiltered or filtered, as required) immediately before sample collection; Do not rinse glass bottles for organics.
  - If concerned with atmosphere, bottle can be filled to overflowing from bottom, otherwise fill to shoulder. Fill at non
  - Samples for volatile organics should contain **NO AIR**. Check for air. If present discard or empty bottle and recollect sample.
  - If necessary, filter sample with in-line filter. Invert and pre-flush filter with sample water; rinse with DI water. Generally use 0.45 um filter. Project objectives dictate pore size and type of filter. Report as **FILTERED, not DISSOLVED.**

PRE-SAMPLING WELL PURGING

- Measurement of well-water volume
- Selection of purge method and pump placement
- Removal of predetermined number of well-water volumes
-

PURGE VOLUME CALCULATION

1. Measure depth to water from reference point
2. Measure or provide well depth (from measuring point) from well log
3. Calculate length of water column (Depth to water – well depth)
4. Calculate casing volume , in gallons (Length of water column x well diameter)
5. Calculate purge volume (casing volume x 3-5)

EXAMPLE PURGE-VOLUME CALCULATION

1. Depth to water = 10 ft
2. Well depth = 20 ft
3. Water column = 10 ft
4. Casing volume = 10 ft x ,163 gallons/ft (for 2-inch diameter well) = 1.63 gallons
5. Purge volume = 1,63 gal x 3 = 4.9 gallons

PURGE METHODS AND STANDARD PROTOCOLS

- Lowering pump – continuous or two step
- Fixed position just above open interval
- Micro-purge
- Dedicated pump – water withdrawn just above or within sample interval
- Use on of these withdrawal methods in conjunction with well-water volume and field characteristic stability criteria

Standard protocols and recommended procedures for conducting and assessing well purging (adapted from Lapham and others, 1995)

1. Purge minimum volume of water equal to 3 times the casing (or wellbore) volume (flow rate 2-3 gal/min or less)

2. Reduce flow rate to 0.1-0.5 gal/min during later part of purge period (5-25 minutes). Lower flow rate will approximate sample collection rate.

3. During purging, monitor pH, temperature, specific conductance, dissolved oxygen (DO), Eh, particularly during final 15-25 minutes. Monitor turbidity (TU) near the end of purging, particularly if sampling for trace elements. Note and record water clarity,

4. The well is considered purged after at least 3 casing volumes have been removed and values of the monitored field parameters between 3-5 successive measurements separated by about 3-5 minute intervals *or* 3 successive ½ well volumes are within the allowable differences specified below:

Parameter	Allowable difference or value
Ph	+- 0.1 units (+-0.05 units if instrument capable of display
Temperature	+-0.2°C
Specific conductance	+- 5%, for SC <- 100 us/cm +-3%, for SC > 100us/cm
DO	+- 0.3 mg/L
Eh	+-5%
TU	+-10% for TU < 100 NTU; ambient TU Is <5 NTU for most ground-water Systems; visible TU > 5 NTU (or check visually for water clarity)

- If measurements appear stable, either the last *or* median value of the last 5 measurements for each parameter (except pH, use last) is recorded; proceed with sampling
- If criteria for stability is not achieved, purging is continued until either measurements stabilize or equivalent of 5 or more wellbore volumes have been removed; note unstable parameters in field notes
- If measurements remain unstable, determine study objectives/sampling priority. If sample, note parameters that are not stable